#### NASA/TM-2000-209891, Vol. 127



# Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall and Jeffrey A. Newcomer, Editors

# **Volume 127 BOREAS TE-1 CO<sub>2</sub> and CH<sub>4</sub> Flux Data over the SSA-OBS Site**

D. Anderson and A. Papagno

National Aeronautics and Space Administration

**Goddard Space Flight Center** Greenbelt, Maryland 20771

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# **Volume 127 BOREAS TE-1 CO<sub>2</sub> and CH<sub>4</sub> Flux Data over the SSA-OBS Site**

Darwin Anderson, University of Saskatchewan, Saskatoon, SK, Canada Andrea Papagno, Raytheon ITSS, NASA Goddard Space Flight Center, Greenbelt, Maryland

National Aeronautics and Space Administration

**Goddard Space Flight Center** Greenbelt, Maryland 20771

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#### BOREAS TE-1 CO<sub>2</sub> and CH<sub>4</sub> Flux Data over the SSA-OBS Site

Darwin Anderson, Andrea Papagno

#### **Summary**

The BOREAS TE-1 team collected various data to characterize the soil-plant systems in the BOREAS SSA. Particular emphasis was placed on nutrient biochemistry, the stores and transfers of organic carbon, and how the characteristics were related to measured methane fluxes. The overall transect in the Prince Albert National Park (Saskatchewan, Canada) included the major plant communities and related soils that occurred in that section of the boreal forest. Soil physical, chemical, and biological measurements along the transect were used to characterize the static environment, which allowed them to be related to methane fluxes. Chamber techniques were used to provide a measure of methane production/uptake. Chamber measurements coupled with flask sampling were used to determine the seasonality of methane fluxes. This particular data set contains carbon dioxide and methane flux values from the SSA-OBS site. The data were collected from 09-Jun to 04-Sep-1994. The data are stored in tabular ASCII files.

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#### 1. Data Set Overview

#### 1.1 Data Set Identification

BOREAS TE-01 CO<sub>2</sub> and CH<sub>4</sub> Flux Data over the SSA-OBS Site

#### 1.2 Data Set Introduction

Particular emphasis in this study was on nutrient biochemistry, the stores and transfers of organic carbon, and how the characteristics were related to measured methane fluxes. The transect in Prince Albert National Park (PANP) included the major plant communities and related soils that occurred in that section of the boreal forest. Soil physical, chemical, and biological measurements along the transect were used to characterize the static environment, which allowed them to be related to methane

fluxes. Chamber techniques were used to provide a measure of methane production/uptake. Chamber measurements coupled with flask sampling were used to determine the seasonality of methane fluxes.

#### 1.3 Objective/Purpose

The objective of the research was to characterize the methane and carbon dioxide soil flux at the BOReal Ecosystem-Atmosphere Study (BOREAS) Southern Study Area (SSA) Old Black Spruce (OBS).

#### 1.4 Summary of Parameters

The main parameters are daily and nightly CH<sub>4</sub> and CO<sub>2</sub> fluxes.

#### 1.5 Discussion

None given.

#### 1.6 Related Data Sets

BOREAS TGB-01 CH4 Tower flux data over NSA BOREAS TGB-01 CO2 and CH4 Chamber Flux data over the NSA BOREAS TGB-01/TGB-03 NEE Data over the NSA Fen BOREAS TGB-03 CO2 and CH4 Chamber Flux data over the NSA BOREAS TGB-05 CO, CO2, and CH4 Chamber Flux data over the NSA

#### 2. Investigator(s)

#### 2.1 Investigator(s) Name and Title

Dr. Darwin Anderson Research Professor University of Saskatchewan

#### 2.2 Title of Investigation

Stores and Dynamics of Organic Matter in Boreal Ecosystems

#### 2.3 Contact Information

#### Contact 1:

Dr. Darwin Anderson Department of Soil Science University of Saskatchewan Saskatoon, Saskatchewan S7N0W0 (306) 966-6827 (306) 966-6881 (fax)

#### Contact 2:

Andrea Papagno Raytheon ITSS NASA GSFC Code 923 Greenbelt, MD 20771 (301) 286-3134 (301) 286-0239 (fax) Andrea.Papagno@gsfc.nasa.gov

#### 3. Theory of Measurements

None given.

#### 4. Equipment

#### 4.1 Sensor/Instrument Description

#### 4.1.1 Collection Environment

CH<sub>4</sub> and CO<sub>2</sub> fluxes were measured during all ambient environmental conditions at the sites.

#### 4.1.2 Source/Platform

Ground.

#### 4.1.3 Source/Platform Mission Objectives

The mission objective was to determine the flux of CH<sub>4</sub> and CO<sub>2</sub> at the SSA-OBS site.

#### 4.1.4 Key Variables

The key variables measured during the fluxes were CH<sub>4</sub> and CO<sub>2</sub> flux.

#### 4.1.5 Principles of Operation

None given.

#### 4.1.6 Sensor/Instrument Measurement Geometry

Not applicable.

#### 4.1.7 Manufacturer of Sensor/Instrument

None given.

#### 4.2 Calibration

None given.

#### 4.2.1 Specifications

#### 4.2.1.1 Tolerance

None given.

#### 4.2.2 Frequency of Calibration

None given.

#### 4.2.3 Other Calibration Information

None given.

#### 5. Data Acquisition Methods

None given.

#### 6. Observations

#### **6.1 Data Notes**

None given.

#### **6.2 Field Notes**

None given.

#### 7. Data Description

#### 7.1 Spatial Characteristics

#### 7.1.1 Spatial Coverage

The North American Datum of 1983 (NAD83) coordinates of the SSA-OBS flux tower (site id G8I4T), close to where the measurements were taken, are 53.98717° N Lat, 105.11779° W Long, Universal Transverse Mercator (UTM) Zone 13, N: 5,982,100.5, E: 492,276.5.

#### 7.1.2 Spatial Coverage Map

Not available.

#### 7.1.3 Spatial Resolution

These are point source measurements along a transect near the given location.

#### 7.1.4 Projection

Not applicable.

#### 7.1.5 Grid Description

Not applicable.

#### 7.2 Temporal Characteristics

#### 7.2.1 Temporal Coverage

The data were collected from 09-Jun to 04-Sep-1994.

#### 7.2.2 Temporal Coverage Map

Not available.

#### 7.2.3 Temporal Resolution

Measurements were collected on a daily basis. Mean flux measurements were calculated every 2 to 10 days from 09-Jun to 04-Sep-1994. The mean and standard deviation of the nighttime methane measurements were taken during the night of 14-Aug to 3 a.m. 15-Aug-1994.

#### 7.3 Data Characteristics

#### 7.3.1 Parameter/Variable

The parameters contained in the data files on the CD-ROM are:

Column Name
-----SITE\_NAME
SUB\_SITE
DATE\_OBS
MEAN\_CH4\_FLUX

STD\_ERR\_CH4
CH4\_FLUX\_NIGHT
STD\_ERR\_CH4\_NIGHT
MEAN\_CO2\_FLUX
STD\_ERR\_CO2
CO2\_FLUX\_NIGHT
STD\_ERR\_CO2\_NIGHT
CRTFCN\_CODE
REVISION\_DATE

#### 7.3.2 Variable Description/Definition

The descriptions of the parameters contained in the data files on the CD-ROM are:

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.
SUB_SITE	The identifier assigned to the sub-site by BOREAS, in the format GGGGG-IIIII, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument.
DATE_OBS	The date on which the data were collected.
MEAN_CH4_FLUX	Mean of all daily methane flux measurements.
STD_ERR_CH4	Standard error of means.
CH4_FLUX_NIGHT	Measurements done during the night of Aug 14 to 3 AM Aug 15.
STD_ERR_CH4_NIGHT	Standard error for measurements done during the night of Aug 14 to 3 AM Aug 15.
MEAN_CO2_FLUX	Mean of the daily CO2 flux measurements.
STD_ERR_CO2	Standard error of means.
CO2_FLUX_NIGHT	Measurements done during the night of Aug 14 to 3 AM Aug 15.
STD_ERR_CO2_NIGHT	Standard error for measurements done during the night of Aug 14 to 3 AM Aug 15.
CRTFCN_CODE	The BOREAS certification level of the data.  Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).
REVISION_DATE	The most recent date when the information in the referenced data base table record was revised.

#### 7.3.3 Unit of Measurement

The measurement units for the parameters contained in the data files on the CD-ROM are:

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
MEAN_CH4_FLUX	[micromoles][meter^-2][second^-1]
STD_ERR_CH4	[micromoles][meter^-2][second^-1]
CH4_FLUX_NIGHT	[micromoles][meter^-2][second^-1]
STD_ERR_CH4_NIGHT	[micromoles][meter^-2][second^-1]
MEAN_CO2_FLUX	[micromoles][meter^-2][second^-1]
STD_ERR_CO2	[micromoles][meter^-2][second^-1]
CO2_FLUX_NIGHT	[micromoles][meter^-2][second^-1]
STD_ERR_CO2_NIGHT	[micromoles][meter^-2][second^-1]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

#### 7.3.4 Data Source

The sources of the parameter values contained in the data files on the CD-ROM are:

Column Name	Data Source
SITE_NAME	[BORIS Designation]
SUB_SITE	[BORIS Designation]
DATE_OBS	[Human Observer]
MEAN_CH4_FLUX	[Laboratory Equipment]
STD_ERR_CH4	[Laboratory Equipment]
CH4_FLUX_NIGHT	[Laboratory Equipment]
STD_ERR_CH4_NIGHT	[Laboratory Equipment]
MEAN_CO2_FLUX	[Laboratory Equipment]
STD_ERR_CO2	[Laboratory Equipment]
CO2_FLUX_NIGHT	[Laboratory Equipment]
STD_ERR_CO2_NIGHT	[Laboratory Equipment]
CRTFCN_CODE	[BORIS Designation]
REVISION_DATE	[BORIS Designation]

#### 7.3.5 Data Range

The following table gives information about the parameter values found in the data files on the CD-ROM.

	Minimum	Maximum	Missng	Unrel	Below	Data
	Data	Data	Data	Data	Detect	Not
Column Name	Value	Value	Value	Value	Limit	Cllctd
SITE_NAME	SSA-OBS-FLXTR	SSA-OBS-FLXTR	None	None	None	None
SUB_SITE	9TE01-FLX01	9TE01-FLX01	None	None	None	None
DATE_OBS	09-JUN-94	04-SEP-94	None	None	None	None
MEAN_CH4_FLUX	000081	.0974537	None	None	None	None
STD_ERR_CH4	.00001157	.01157407	-999	None	None	None
CH4_FLUX_NIGHT	.01094907	.05153935	-999	None	None	None
STD_ERR_CH4_NIGHT	.00322917	.00322917	-999	None	None	None
MEAN_CO2_FLUX	-1.5966782	2.0808912	-999	None	None	None
STD_ERR_CO2	.02233	1.20968	-999	None	None	None

CO2_FLUX_NIGHT STD_ERR_CO2_NIGHT CRTFCN_CODE REVISION_DATE	.2525 CPI	1.8601 .47403 CPI 07-NOV-96	None			
Minimum Data Value Maximum Data Value Missng Data Value	The maximum v The value tha indicate that	alue found in t t indicates mis an attempt was	the colum ssing dat s made to	n. a. This determ	ine the	. to
Unrel Data Value	parameter value, but the attempt was unsuccessful.  The value that indicates unreliable data. This is used to indicate an attempt was made to determine the parameter value, but the value was deemed to be unreliable by the analysis personnel.					
Below Detect Limit	The value that instruments d indicate that parameter valuetat that the parameter that		rameter vs. This made to alysis pe	alues b is used determ rsonnel	l to nine the . determi	
Data Not Cllctd	This value in determine the indicates tha not identical	dicates that no parameter valu t BORIS combine data sets into icular science	o attempt ue. This ed severa o the sam	usuall l simil e data	y ar but	le
Blank Indicates N/A Indicates None Indicates	that the value i	s not applicab	le to the	respec	tive col	

#### 7.4 Sample Data Record

The following are wrapped versions of data record from a sample data file on the CD-ROM. SITE\_NAME, SUB\_SITE, DATE\_OBS, MEAN\_CH4\_FLUX, STD\_ERR\_CH4, CH4\_FLUX\_NIGHT, STD\_ERR\_CH4\_NIGHT, MEAN\_CO2\_FLUX, STD\_ERR\_CO2, CO2\_FLUX\_NIGHT, STD\_ERR\_CO2\_NIGHT, CRTFCN\_CODE, REVISION\_DATE

- 'SSA-OBS-FLXTR','9TE01-FLX01',09-JUN-94,.00018519,-999.0,.05153935,-999.0,-999.
- 'SSA-OBS-FLXTR','9TE01-FLX01',09-JUN-94,-.000081,.00001157,.01094907,.00322917,
- -999.0,-999.0,1.4959,.27341,'CPI',07-NOV-96

### 8. Data Organization

#### 8.1 Data Granularity

The smallest unit of data tracked by the BOREAS Information System (BORIS) was the data collected at a given site on a given date.

#### 8.2 Data Format(s)

The Compact Disk-Read-Only Memory (CD-ROM) files contain American Standard Code for Information Interchange (ASCII) numerical and character fields of varying length separated by commas. The character fields are enclosed with single apostrophe marks. There are no spaces between the fields.

Each data file on the CD-ROM has four header lines of Hyper-Text Markup Language (HTML) code at the top. When viewed with a Web browser, this code displays header information (data set title, location, date, acknowledgments, etc.) and a series of HTML links to associated data files and related data sets. Line 5 of each data file is a list of the column names, and line 6 and following lines contain the actual data.

#### 9. Data Manipulations

#### 9.1 Formulae

#### 9.1.1 Derivation Techniques and Algorithms None given.

#### 9.2 Data Processing Sequence

## 9.2.1 Processing Steps

None given.

#### 9.2.2 Processing Changes None given.

#### 9.3 Calculations

#### 9.3.1 Special Corrections/Adjustments None given.

#### 9.3.2 Calculated Variables None given.

#### 9.4 Graphs and Plots

None.

#### 10. Errors

#### 10.1 Sources of Error None given.

10.2 Quality Assessment

# 10.2.1 Data Validation by Source

None given.

#### 10.2.2 Confidence Level/Accuracy Judgment None given.

#### **10.2.3 Measurement Error for Parameters** None given.

## 10.2.4 Additional Quality Assessments

None given.

#### 10.2.5 Data Verification by Data Center

Data were examined for general consistency and clarity.

#### 11. Notes

#### 11.1 Limitations of the Data

None given.

#### 11.2 Known Problems with the Data

None given.

#### 11.3 Usage Guidance

None given.

#### 11.4 Other Relevant Information

None given.

#### 12. Application of the Data Set

None given.

#### 13. Future Modifications and Plans

This data set is in its final format.

#### 14. Software

#### 14.1 Software Description

None given.

#### 14.2 Software Access

None given.

#### 15. Data Access

The CO<sub>2</sub> and CH<sub>4</sub> flux data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

#### **15.1 Contact Information**

For BOREAS data and documentation please contact:

ORNL DAAC User Services Oak Ridge National Laboratory P.O. Box 2008 MS-6407 Oak Ridge, TN 37831-6407

Phone: (423) 241-3952 Fax: (423) 574-4665

E-mail: ornldaac@ornl.gov or ornl@eos.nasa.gov

#### 15.2 Data Center Identification

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics http://www-eosdis.ornl.gov/.

#### 15.3 Procedures for Obtaining Data

Users may obtain data directly through the ORNL DAAC online search and order system [http://www-eosdis.ornl.gov/] and the anonymous FTP site [ftp://www-eosdis.ornl.gov/data/] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

#### 15.4 Data Center Status/Plans

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

#### 16. Output Products and Availability

#### **16.1 Tape Products**

None.

#### 16.2 Film Products

None.

#### 16.3 Other Products

These data are available on the BOREAS CD-ROM series.

#### 17. References

# 17.1 Platform/Sensor/Instrument/Data Processing Documentation None.

#### 17.2 Journal Articles and Study Reports

Newcomer, J., D. Landis, S. Conrad, S. Ĉurd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. 2000. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM.

Sellers, P. and F. Hall. 1994. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1994-3.0, NASA BOREAS Report (EXPLAN 94).

Sellers, P. and F. Hall. 1996. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1996-2.0, NASA BOREAS Report (EXPLAN 96).

Sellers, P., F. Hall, and K.F. Huemmrich. 1996. Boreal Ecosystem-Atmosphere Study: 1994 Operations. NASA BOREAS Report (OPS DOC 94).

Sellers, P., F. Hall, and K.F. Huemmrich. 1997. Boreal Ecosystem-Atmosphere Study: 1996 Operations. NASA BOREAS Report (OPS DOC 96).

Sellers, P., F. Hall, H. Margolis, B. Kelly, D. Baldocchi, G. den Hartog, J. Cihlar, M.G. Ryan, B. Goodison, P. Crill, K.J. Ranson, D. Lettenmaier, and D.E. Wickland. 1995. The boreal ecosystem-atmosphere study (BOREAS): an overview and early results from the 1994 field year. Bulletin of the American Meteorological Society. 76(9):1549-1577.

Sellers, P.J., F.G. Hall, R.D. Kelly, A. Black, D. Baldocchi, J. Berry, M. Ryan, K.J. Ranson, P.M. Crill, D.P. Lettenmaier, H. Margolis, J. Cihlar, J. Newcomer, D. Fitzjarrald, P.G. Jarvis, S.T. Gower, D. Halliwell, D. Williams, B. Goodison, D.E. Wickland, and F.E. Guertin. 1997. BOREAS in 1997: Experiment Overview, Scientific Results and Future Directions. Journal of Geophysical Research 102(D24): 28,731-28,770.

## 17.3 Archive/DBMS Usage Documentation

#### 18. Glossary of Terms

None.

#### 19. List of Acronyms

AES - Atmospheric Environment Services

ASCII - American Standard Code for Information Interchange

BOREAS - BOReal Ecosystem-Atmosphere Study

BORIS - BOREAS Information System

BP - Beaver Pond

CD-ROM - Compact Disk-Read-Only Memory

CMDL - Climate Monitoring and Diagnostics Laboratory

DAAC - Distributed Active Archive Center

ECD - Electron Capture Detector
EOS - Earth Observing System

EOSDIS - EOS Data and Information System

FID - Flame Ionization Detector

GC - Gas Chromatograph

GIS - Geographic Information System
GSFC - Goddard Space Flight Center
HTML - Hypertext Markup Language
NAD83 - North American Datum of 1983

NASA - National Aeronautics and Space Administration

NSA - Northern Study Area OBS - Old Black Spruce

ORNL - Oak Ridge National Laboratory PANP - Prince Albert National Park

SSA - Southern Study Area

TCD - Thermal Conductivity Detector

TE - Terrestrial Ecology

TGB - Trace Gas Biogeochemistry
URL - Uniform Resource Locator
UTM - Universal Transverse Mercator

#### 20. Document Information

#### 20.1 Document Revision Date

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#### 20.2 Document Review Date(s)

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When using these data, please contact the individuals listed in Section 2.3 as well as citing relevant papers in Section 17.2.

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The BOREAS TE-1 team collected various data to characterize the soil-plant systems in the BOREAS SSA. Particular emphasis was placed on nutrient biochemistry, the stores and transfers of organic carbon, and how the characteristics were related to measured methane fluxes. The overall transect in the Prince Albert National Park (Saskatchewan, Canada) included the major plant communities and related soils that occurred in that section of the boreal forest. Soil physical, chemical, and biological measurements along the transect were used to characterize the static environment, which allowed them to be related to methane fluxes. Chamber techniques were used to provide a measure of methane production/uptake. Chamber measurements coupled with flask sampling were used to determine the seasonality of methane fluxes. This particular data set contains carbon dioxide and methane flux values from the SSA-OBS site. The data were collected from 09-Jun to 04-Sep-1994. The data are stored in tabular ASCII files.

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